Organic and isotopic biomarkers of Antarctic endolith microbial communities

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Antarctic endolithic microbial communities are hypothesized to be among the slowest growing communities on Earth. However, there are few constraints on this estimate and its potential variability. Organic biomarkers and associated isotopic analyses (^{13}C, ^{14}C) were used to constrain carbon sources and cycling in endoliths recovered from two locations in the Antarctic Dry Valleys, University Valley (UV) and Farnell Valley (FV). Phospholipid fatty acids (PLFA) and glycolipid fatty acids (GLFA) were extracted from these communities and represent viable cells and long term storage/degradation products respectively.

Concentrations of PLFA generated from the polar lipid fraction were 1.1 to 5.5 ug/g while GLFA from the apolar fraction were 0.6 to 8.2 ug/g. FV endoliths had the highest overall concentrations and ratio of GLFA to PLFA of 1.5:1. PLFA and GLFA profiles were dominated by monoenoics (16:1 and 18:1) in most UV samples, while in FV 18:2 was dominant (> 50%) and long chain PLFA (> 20:0) were present indicative of eukaryotes. PLFA $\delta^{13}C$ values were depleted from bulk organic $\delta^{13}C$ values of ca. -31 ‰ by ca. 2 – 3 ‰ indicating heterotrophic synthesis. PLFA and GLFA were within 1 – 2 ‰ of each other and thus indistinguishable.

PLFA $\Delta^{14}C$ values ranged from -199 to -79‰ (UV) and +40 ‰ (FV). The $\Delta^{14}C$ value of FV PLFA is consistent with cycling of carbon from the modern atmosphere. In contrast, UV systems are comprised of carbon with radiocarbon ages of 1,780 to 665 years, consistent with very slow carbon cycling and/or recycling of older carbon within the community. The GLFA fraction was more ^{14}C-depleted than the PLFA in all samples (by 264 to 55‰) indicating persistence of biomarkers in this fraction and a potential source of recycled carbon to endolith microbial communities. Differences between University and Farnell Valley viable cell carbon ages and cycling may reflect variations in the microbial communities and/or adaptations to environmental differences between the two valleys.